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IN THIS ISSUE

DDT Fly Control by Airplane

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Public Health Reports

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The Airplane Application of DDT for Emergency Control of Common Flies in the Urban Community

By Cornelius W. Krusé [1]

The only sound approach to a community fly control program is through the continuing practice of environmental sanitation. The routine use of DDT in a fly control program offers little more than a temporary solution to the problem and cannot be justified over a long period of time any more than rat poisoning or mosquito larviciding. Household and commercial garbage must be kept in tightly covered containers, frequently collected and disposed of in a satisfactory manner. Continuous good housekeeping is of utmost importance. Carelessness with poultry, pets, compost or even grass cuttings may result in a sustained fly population in the finest sections of a community. There are enterprises admittedly difficult to maintain free of flies. Through relaxed vigilance they may become a source of heavy fly densities. Among them are garbage dumps, slaughterhouses, stables, produce houses, rendering plants, waste disposal plants, canneries, milk plants, and tanneries.

Studies on urban fly populations recently made using the "fly grill" method devised by Scudder (*1*) indicate that communities may have larger fly populations than may be realized by residents living behind the protective screens. These findings have renewed interest in the public health significance of flies and stimulated study of fly control methods. The control of houseflies by DDT spray applied as residual in dairies and restaurants and as cover sprays on breeding places has been adequately reported by Baker, et al. (*2*), but there appears to be a paucity of literature on the control of flies by the application of DDT from airplanes. Airplane equipment seems to be ideally suited for bringing about temporary fly control rapidly and effectively in urban areas during time of emergency such as epidemics, catastrophe, or war.

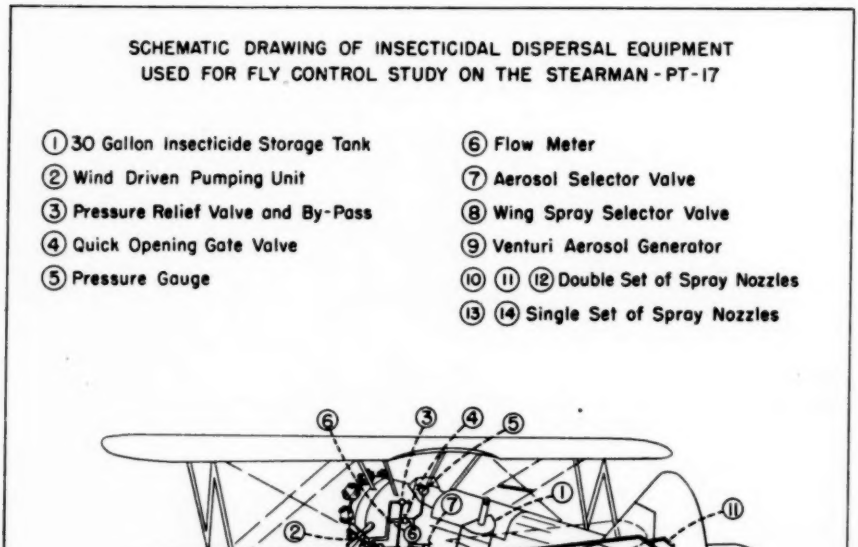
[1] Johns Hopkins University, Engineering Consultant, Public Health Service, Communicable Disease Center.

The practicability of emergency fly control in urban areas was demonstrated by Quinby, Coffey, and McNeel in northern Alabama in 1946 (*3*).

This report deals only with investigations concerning the design of aircraft spray equipment and performance against common flies found in urban areas.

Equipment

The equipment used in all tests was the Stearman PT–17 [2] biplane trainer powered with the 220 hp. Continental engine, the same ship used on the Florence project (*3*). The airplane was equipped for the application of either sprays or thermal aerosols affording a wide variety of treatments ranging from very fine droplets to coarse sprays. This airplane was capable of treating 17 acres per minute with a 100-foot swath width. Figure 1 represents a flow diagram of the installed insecticidal equipment showing the wind-driven


SCHEMATIC DRAWING OF INSECTICIDAL DISPERSAL EQUIPMENT
USED FOR FLY CONTROL STUDY ON THE STEARMAN - PT-17
① 30 Gallon Insecticide Storage Tank
② Wind Driven Pumping Unit
③ Pressure Relief Valve and By-Pass
④ Quick Opening Gate Valve
⑤ Pressure Gauge
⑥ Flow Meter
⑦ Aerosol Selector Valve
⑧ Wing Spray Selector Valve
⑨ Venturi Aerosol Generator
⑩ ⑪ ⑫ Double Set of Spray Nozzles
⑬ ⑭ Single Set of Spray Nozzles
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OCT. 1948

FIGURE 1

[2] For the purpose of this report it was necessary to use the names of commercial types of airplanes, engines, sprays, spray nozzles, solvents, and in certain cases insecticides, etc. Such commercial names are used solely for identification. Similar products of other manufacturers may be found equally effective.

pumping unit on the wing and the various discharge lines leading either to the throat of the 2-inch exhaust venturi or to the spray nozzles. Eight spray nozzles could be installed, arranged in groups of two on wing tips and tail, with a single nozzle on the inboard wing positions. Various rates of discharge were obtained by adjusting the discharge pressure through a by-pass valve on the instrument panel. The required discharge pressures were determined through the use of a flow meter. Owing to the simplicity and versatility of this apparatus, many private insecticidal spraying organizations have duplicated the equipment for contract work.

Since the investigations described in this paper are so closely related to the Florence (*3*) activity, a review of some of the pertinent data and observations obtained on that project would be in order at this time.

Important departures from standard aircraft insecticidal techniques are required in urban fly control. Normally, insecticidal applications are made at a height of 20 to 30 feet during inversion conditions existing just after dawn. When applying insecticides over buildings of a community, or in steep or hilly terrain, flight altitudes much below 100 feet are prevented. The average height is 150 feet. For most effective urban control, the insecticides should be applied when the flies are most active, which is late in the morning after winds and unstable air conditions have developed. Special consideration must be given to the selection of insecticides and solvents in order to minimize the staining effect of the droplets on laundry, automobiles, and other community property.

Reasonably good fly kill can be accomplished, but with significant staining, by applying a DDT thermal aerosol at the rate of 0.4-pound. DDT per acre. This aerosol and dosage rate was obtained by discharging a 20-percent solution of DDT in Velsicol NR–70 through two 8010 Spraying Systems Company nozzles into the throat of the 2-inch exhaust venturi. Recovery of DDT from this type aerosol under field conditions ranged from 0.054 to 1.0 pound DDT per acre at a flight altitude between 50 and 100 feet. An analysis of the composition of the aerosol shows the median mass diameter to be in the range 120–150 microns with one-half of the droplets being below 80 microns in diameter.

It was thought by this investigator that the back pressure created by the flow of 3 gallons per minute into the exhaust generator would prove excessive and cause damage to the engine exhaust valves. Therefore, a series of engine back pressure readings was taken at various rates of insecticide flow. Data were obtained for the 2-inch diameter venturi and for insecticide injected directly into the 4-inch exhaust stack with the venturi removed. Figure 2 is the plot of back pressure in inches of mercury against insecticide flow.

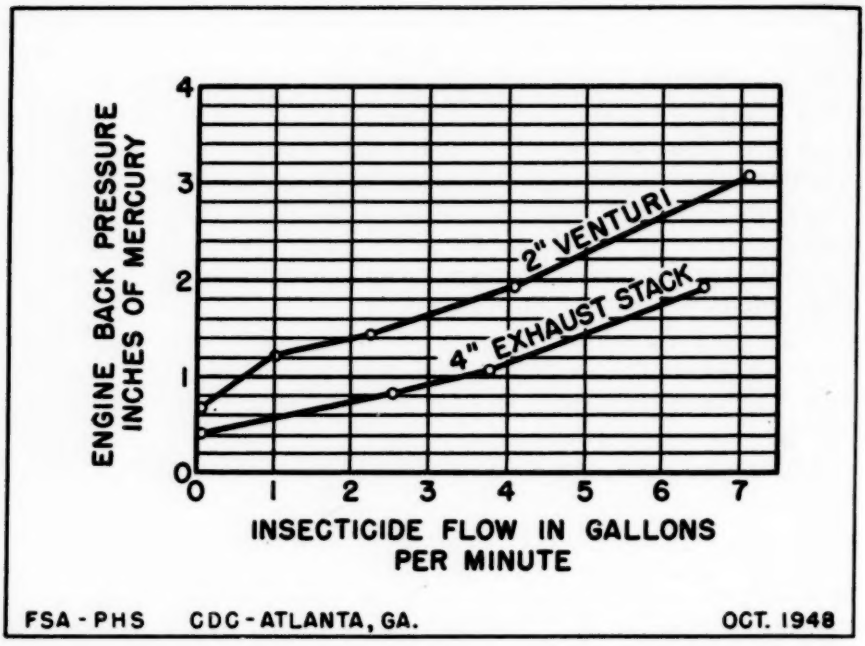

FIGURE 2. The relationship of engine back pressure to insecticide flow in the 2-inch venturi generator and the 4-inch exhaust stack.

All readings were made aloft with the engine turning at cruising rpm. It was generally agreed after study of cylinder-head temperatures that prolonged engine operation at pressure over 1.6 inches of mercury would not be advisable. This would limit the flow into the 2-inch venturi to 2.5 gpm. or 5.5 gpm. in the 4-inch exhaust stack.

Studies were initiated to eliminate the engine back pressure and to obtain good DDT recovery and fly control without producing staining droplets of insecticide. To decrease the discharge rate of insecticidal solution, the concentration of DDT was increased from 20 percent to 30 percent by weight. The use of the 30 percent solution increased the rates of ground recovery and provided a more toxic droplet. The following dispersal equipment was studied for recovery and fly control in view of wide differences in droplet size and distribution pattern: (1) Aerosols generated in the 2-inch diameter venturi; (2) aerosols generated in the 4-inch diameter exhaust stack; (3) wing sprays using cone-type atomizing nozzles; (4) wing sprays using flat-type atomizing nozzles.

Insecticidal Formulations

The methylated naphthalenes have been demonstrated to maintain stable solutions up to 50 percent DDT by weight at room temperature. Velsicol NR–70 was initially used but due to its high staining

property, efforts were made to find a more suitable fraction. Five Velsicol fractions were studied. Table 1 gives the weight of the mixed solutions in pounds per gallon and staining property of droplets on white paper. It also gives the characteristic crystal pattern obtained with each solvent.

All of the materials tested showed a high solvency for DDT. The staining properties of droplets were hardly noticeable on the lighter fractions below AR–70. The volatility of the solvents was quite variable. AR–50G was so volatile that smaller droplets were completely evaporated immediately after a fall from 100-foot heights. Since the effectiveness of the droplet is believed to be dependent upon its ability to wet the cuticle of the fly, it appeared advisable not to use AR–50G. The fraction AR–50 was not so volatile and the droplets would not crystalize for from 12 to 24 hours after spraying. Droplets of AR–60 would remain on glass slides from 2 to 3 days while droplets of AR–70 and NR–70 would persist for a week or more. Considering cost, staining ability, and volatility, AR–60 was selected as the preferred solvent for the fly-control study. Keener and Cutkomp (*4*) have shown that this material possesses many physical properties quite similar to NR–70 and could be used for thermal aerosols, as well as wing sprays.

Table 1. ***Weight of mixed solutions in pounds per gallon***

DDT by weight	Velsicol [1]				
	AR–50G	AR–50	AR–60	AR–70	NR–70
20 percent	8.35	8.54	8.50	8.85	8.75
25 percent	8.46	8.62	8.57	8.94	8.81
30 percent	8.56	8.70	8.68	8.97	8.95
Staining property	None	None	None	Very light	Dark brown
Crystal pattern	Short fine needles	Frost-like needles	Brush-like rods	Brush-like rods	Heavy rods

[1] Velsicol Corporation, Chicago, Ill.

Field Investigation

Airplane application of insecticide is accomplished by flying a series of parallel swaths over the area. The effective swath width and rate of application can be determined only when the cross section of insecticide recovery is known for a particular dispersal equipment.

The recovery of DDT across a swath section was determined by analyzing droplets collected on clean glass slides placed at 20-foot intervals at right angles to the line of flight. Eleven stations were studied for a distance of 100 feet to either side of the flight line. Winds as a factor on swath characteristics were minimized by conducting flight tests in the early morning hours after dawn. Procedures for obtaining the quantitative rate of surface recovery were similar to

the methods used for the study of airplane exhaust generators as described by Krusé and Metcalf (*5*).

Solutions of DDT applied from aircraft kill flies when the flies come in direct contact with falling droplets and in contact with sprayed surfaces. The former is immediate in its action while the latter may provide a residual over a period of time. The relative efficiency of contact and residual action of the spray droplets was not completely investigated and should warrant future study. With the spray normally used an average of 49 droplets of insecticide was recovered per square inch of area (see table 3).

Estimating an effective exposure area of the fly to be about 0.25 square centimeter, the expected frequency of contacting flies with the spray was determined by a random distribution following Poisson's series. If the mean number of droplets per unit of fly area is 1.9 and a number of samples of this unit area are taken, then the distribution of these samples or flies with regard to number of droplets hitting each will be as follows:

	Proportion of Flies *Percent*
Complete miss	15. 0
1 droplet	28. 5
2 droplets	27. 0
3 droplets	17. 2
4 droplets	8. 2
5 droplets	3. 1
6 droplets	<1. 0
	100. 0

Thus it may be seen that complete kill by contact spray is not possible even if it is assumed that a single droplet will contain a lethal concentration of insecticide. In actual spray tests the observed residual action appeared to be quite variable and of relatively short duration. It must be remembered that in the application of spray droplets continuous deposits of insecticides are unattainable. Therefore, recovery slides having a deposit of droplets equivalent to 0.1 pound DDT/acre (1.04 mg./sq. ft.) may have the DDT applied on less than 1 percent of the area and show very localized points of high DDT concentrations. The concentration of DDT in the spread droplet on clean glass is given below:

Droplet Diameter Microns	*Spread Droplet Area Cm²*	*Equivalent Rate mg. DDT/sq. ft.*
50	0. 00018	132
100	. 00071	270
200	. 0028	468
250	. 0044	630

On paper, soil, pavements and other urban surfaces the spread factor

is quite high and the concentration of DDT is greatly reduced when compared with clean glass surfaces. Clean glass slides receiving airplane spray deposits equivalent to 0.1-pound DDT/acre were exposed to 3 sets of 20 *Musca domestica* for 1 hour. Fifty-seven out of 60 specimens received a lethal dose. Slides having the same deposit stored in a slide box for 3 weeks, after which droplets had crystallized, killed only 11 out of 60 *Musca domestica* exposed for 1 hour. These tests confirm the field impression that droplets applied out-of-doors are more residually effective in solution form than in crystalline form. The explanation may lie in more rapid absorption of the insecticidal solution. Also the toxicity of the polymethylnaphthalene itself cannot be overlooked.

Similar tests conducted on dirty newspaper provided about 50 percent kill with a 3-hour contact period when freshly sprayed, but no kill was obtained on the paper after 3 days on an open dump. Wet droplets on rusty sheet metal gave the same degree of kill as for dirty paper. On garbage, such as interior of watermelon, little or no residual effect was noted even immediately after spraying.

Due to the difficulty in establishing a reasonable estimate of fly surface capable of contacting the spray pattern, it is not possible to predict the frequency of contact between the fly and droplet. With an assumed tarsal contact area per fly of 0.06 square centimeter, the fly may be expected to come to rest on a droplet only 6 times out of 100 landings. The probability of contact with droplets in the course of surface travel is much greater. Contact with one or more droplets may be expected to occur 25 percent of the time with a surface travel of 3 to 4 fly lengths.

With the given insecticidal spray and considering the characteristic surfaces of urban situations, it was concluded that residual action cannot be depended upon to provide more than 10 percent to 50 percent fly mortality. Therefore, emphasis was placed on DDT dispersal to provide at least 75 percent mortality by direct contact of falling droplets on the fly.

For correlating the dosage recovered with fly mortality, techniques were developed using wild flies collected from garbage dumps. By carefully selecting bait, the fly population captured was composed of approximately 49 percent *Musca domestica*, 45 percent *Phaenicia* spp. 5 percent *Callitroga* spp., and 1 percent miscellaneous flies. The miscellaneous flies included species of the genera *Ophyra*, *Fannia*, and *Sarcophaga*.

Caged insects have been used for bio-assay of insecticidal sprays but as a general rule results have been difficult to evaluate in terms of actual field conditions. Much of the finer spray passed around the screen cage and the larger droplets impinged upon the cage rather than

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the insect. Also, it was necessary to remove the flies from the sprayed cage to eliminate mortality caused by residual dose on the screen.

It was observed that flies tend to congregate in large numbers to feed on choice bait and unless violently disturbed, remain relatively motionless. Movements made were quite limited, often not more than 3 or 4 inches away to a more desirable feeding spot. Observed from above, feeding flies assume practically every attitude. When aircraft sprays were applied, the flies continued feeding while the particles settled on and about them. This proved disturbing to the observer since much of the effectiveness of contact sprays is obtained when the insects collect droplets by flying through the spray. Several seconds after being hit by droplets the flies left the feeding area. This accounted for the low number of flies found affected or dead at the feeding site. After spraying, dying flies could be found at their resting places, falling out of shrubs and trees to the ground where their uncoordinated struggling soon buried them in the litter of leaves and grass.

From these observations it appeared that flies anesthetized with ether or chloroform would duplicate fairly well the conditions under which flies would be sprayed in the actual field operation. Early experiments were conducted in this manner, but chloroformed flies recovered rapidly and many test specimens flew away before they could be transferred to clean cages for observation. The final field procedure consisted of lightly anesthetizing the specimens and carefully mounting them on "Tanglefoot" fly paper. The fly was secured, back down, by outspread wings, thereby exposing to the insecticidal spray pattern the legs, mouth parts and ventral areas of the abdomen, thorax, and wings. No difficulty was experienced in maintaining good controls and dosage mortality information checked favorably with the chloroform technique previously tried.

In the field tests, 10 to 20 flies were used on 4- by 6-inch sheets of fly paper which were laid with the horizontal glass slides for dosage information at each station. After the spray tests, the sheets were placed in a darkened room to minimize fly activity and observations were made at hourly intervals. Fly mortality occurred within 1 to 2 hours after treatment with the maximum in 4 hours. There appeared to be a noticeable species susceptibility. *Musca domestica* was the first species to die within the first hour, followed by *Phaenicia* in the second hour, and finally *Callitroga*. McNeel [3] and others have made similar observations which prompted his unpublished statement that "the brassier the fly, the harder it is to kill." There was considerable variation in mortality for any given applied dosage as may be expected with the small samples of mixed fly species used in the study.

[3] T. E. McNeel, District Entomologist, Public Health Service, New Orleans, La.

Although not highly significant, the purpose for which the data were collected was satisfactorily met. Figure 3 was prepared by plotting on log probability paper the 4-hour fly mortality against pounds per acre of active insecticide recovered using Technical DDT, and Gammexane [4] (10 percent γ isomer). Gammexane (10 percent γ isomer) is used to represent technical 1, 2, 3, 4, 5, 6 hexachlorocyclohexane of which 10 percent by weight is the gamma isomer. These sprays were applied from the aircraft at a height of flight of 100 feet and had median mass diameter (MMD) of from 160 to 200 microns. No effort was made to correlate the effect of the solvent which in most cases was Velsicol AR–60 and NR–70. It may be seen from the curve that to obtain good fly control, recoveries in excess of 0.1

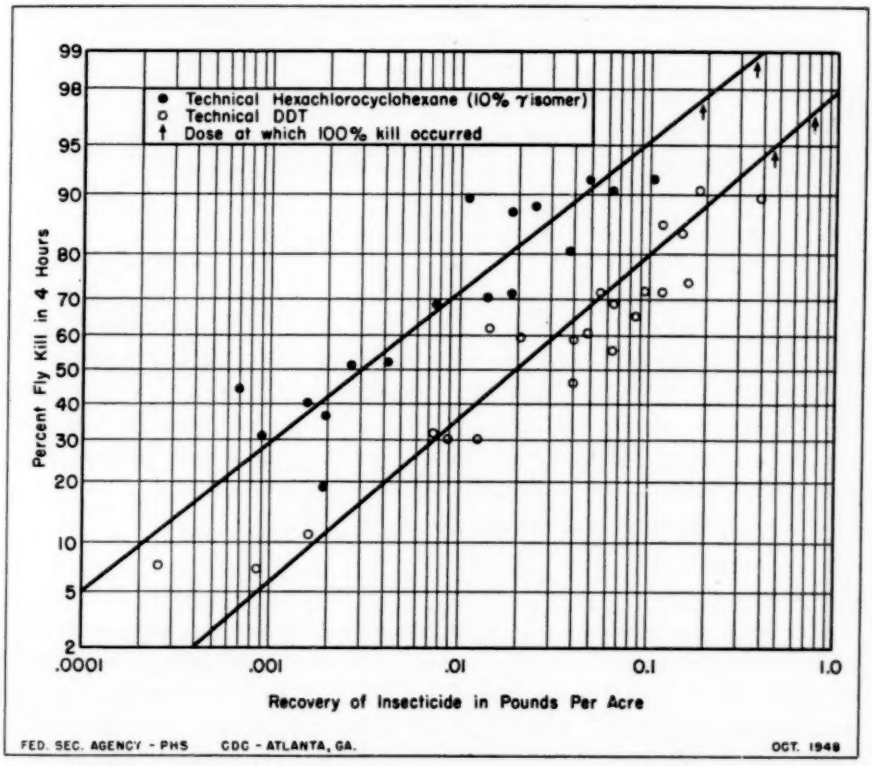

FIGURE 3. Comparison of the relative toxicity to common flies of Technical DDT and Technical Hexachlorocyclohexane (10 percent γ isomer) when applied as sprays from aircraft from an average height of flight of 100 feet. The sprays were composed of particles having a MMD of 160 to 200 microns. Flies were lightly anesthetized and carefully fastened, back down, to fly paper. Ten to 20 individuals were used per sheet. All percentages of mortality were corrected for controls by method of Abbot (1925).

[4] Product of Imperial Chemical Industries.

pound DDT per acre are required. Gammexane (10 percent γ isomer) appears to be 5.5 to 7 times more toxic to the flies studied than DDT.

Table 2. *Comparative toxicity of DDT and Gammexane applied as aircraft sprays to common flies*

Lethal Dose	Required aircraft spray recovery, pounds per acre			Sampling chance probability [1]
	Technical DDT	Gammexane 10 percent	Gamma Isomer	
LD_{50}	0.022	0.003	0.0003	P=0.0500.
LD_{90}	.25	.045	.0045	P=0.0768.

[1] Kills obtained from the given doses of each material would have occurred by chance sampling 5 and 8 times in 100 even if there had been no real difference in the two materials.

Results of Field Tests

The basic unit of aircraft insecticidal application is the swath cross section. To obtain an accurate measurement, several sections must be averaged together. A reliable notion of the MMD of a particular spray is quite difficult to obtain and there appeared to be a wide variation between the calculated and observed MMD for the aerosols. This may be explained in part by the difficulty in obtaining a representative sample of nonhomogeneous aerosols. Some waved slide samples may contain no large droplets while those a few feet to the right or left may have many large droplets. All particle-size diameters mentioned were determined from subsidence particles collected across the swath width. All percentages of expected kill indicated on graphs were those accomplished by the direct contact with spray exclusive of any residual action.

Aerosols

Figure 4 summarizes the data collected on the performance of a 2-inch venturi and the 4-inch exhaust stack. The heavy lines indicate the single swath cross section and the dotted curve the theoretical overlapped section of swaths at 100-foot intervals. The maximum permissable rate of insecticidal flow of 2.5 gpm. was used in the venturi investigation. With the 30-percent DDT–70-percent Velsicol AR–60 solution, this flow gave an application rate of .375-pound DDT per acre assuming a 100-foot swath. The median mass diameter (MMD) of the venturi aerosol was observed to be 100 microns with the mean [5] diameter 65 microns. One half of the particles recovered were below 45 microns in diameter.

[5] To prevent possible confusion between "median mass diameter" and "mean mass diameter" the word: "mean" is used. The mean diameter is defined as that diameter particle whose mass x the total number of droplets recovered will equal the mass recovered.

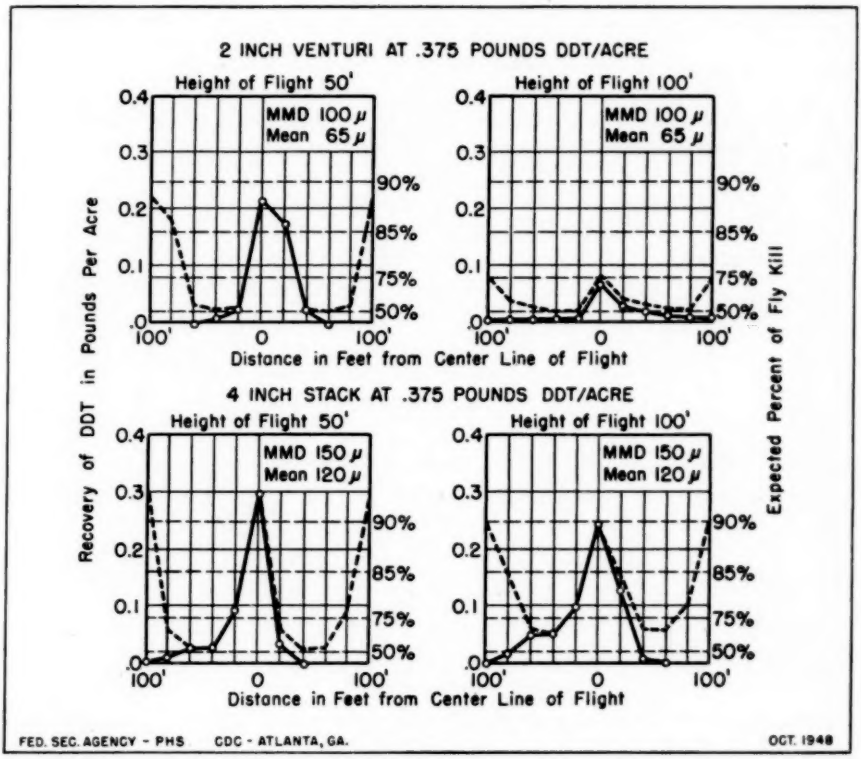
2 INCH VENTURI AT .375 POUNDS DDT/ACRE
Height of Flight 50'
MMD 100 μ
Mean 65 μ
Height of Flight 100'
MMD 100 μ
Mean 65 μ
4 INCH STACK AT .375 POUNDS DDT/ACRE
Height of Flight 50'
MMD 150 μ
Mean 120 μ
Height of Flight 100'
MMD 150 μ
Mean 120 μ
Recovery of DDT in Pounds Per Acre
Expected Percent of Fly Kill
90%
85%
75%
50%
100' 0 100'
Distance in Feet from Center Line of Flight
FED. SEC. AGENCY - PHS CDC - ATLANTA, GA. OCT. 1948

FIGURE 4. Swath cross sections show the recovery in pounds DDT/Acre at flight altitude of 50 and 100 feet with a coarse and fine aerosol.

In the first series of recovery tests shown in figure 4, the effect of height of flight on aerosol recovery is clearly indicated. If it were possible to treat at low altitudes, the venturi-generated aerosols would be quite effective in fly control. Owing to the extremely thin but widespread distribution at increased heights of flight, it appears that the aerosol would result in nonuniform fly mortality.

The second aerosol series was generated by removing the venturi and injecting the insecticide into the exhaust stack through a single ¼-inch diameter jet. At the same rate of application the 4-inch exhaust stack would be more effective than the 2-inch venturi at the 100-foot height of flight. This is due to the much larger droplet pattern produced. The aerosol had a MMD of 150 microns and a mean of 120 microns in diameter. One-half of the total number of droplets recovered were less than 60 microns in diameter. The range was quite wide with droplets varying from 10 to 350 microns. During the experimental trials considerable spray was deposited on the fuselage and tail surfaces. This condition, however, may be corrected by realigning the end section of the exhaust stack to bear away and downward from the ship.

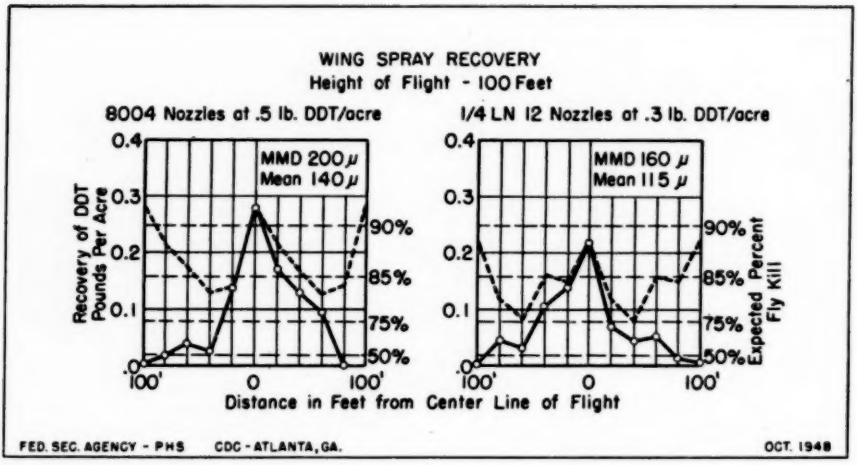

FIGURE 5. Swath cross sections using wing sprays at a flight altitude of 100 feet with application rates of 0.3 and 0.5 pound DDT/Acre.

Wing Sprays

A graphical presentation of the performance of wing sprays is given in figure 5. For the lower rates of application, eight ¼ LN 12 cone-type atomizing spray nozzles were employed and for higher rates, eight 8004 flat-type spray nozzles were used. Both types of nozzles were manufactured by the Spraying Systems Co. The ¼ LN 12 nozzle is rated at 0.2 gpm. at 40 psi., while the 8004 nozzle delivers 0.4 gpm. at 40 psi.

Good recovery was obtained with the ¼ LN 12 at an application rate of 0.3-pound DDT per acre. The spray had a wide range of particles having a MMD of 160 microns and a mean of 115 microns. One-half of the droplets recovered were below 85 microns and were quite similar to the aerosol generated by the 4-inch exhaust stack.

The swath cross sections show that with the 8004 nozzle applying insecticide at 0.5 pound DDT per acre the spray provided a good recovery, however, there is an increased number of large droplets. The spray had a MMD of 200 microns with a mean of 140 microns. One-half of the number of droplets recovered were less than 100 microns in diameter.

Table 3 summarizes the swath cross section studied with reference to expected rates of fly kill when swaths are applied at intervals of 100 feet and at a flight altitude of 100 feet. A 25-percent mortality through residual action has been assumed in the tabulation.

Application of Data to Urban Fly Control

The single swath recovery curve studies represent conditions when the air is stable and wind drift is negligible. The distribution during

Table 3. *Expected percent of area over which at least 90 percent fly control is obtained with 100-foot swath and 100-foot height of flight*

Equipment	Application lbs. DDT/ac.	MMD	No. droplets per sq. in.	Expected percent of area[1] controlled	
				Multiple swaths	Single swath
2-inch venturi	0.375	100	63	15	5
4-inch stack	.375	150	32	65	32
LN-12 spray	.300	160	49	100	39
8004 spray	.500	200	27	100	50

[1] Area assumed to lie 100 feet to the right and left of the line of flight.

actual routine treatment will vary somewhat depending upon the direction and velocity of wind drift and the amount and character of protective cover. Swaths laid up-wind or down-wind will not alter considerably the single swath recovery pattern. Cross winds are most important in altering the pattern of insecticide recovery. It was demonstrated that low velocity cross winds may be quite beneficial in tending to grade down the peak dosages and thereby providing a more uniform distribution. Strong cross winds tend to skew the distribution violently. They also interfere with maintaining parallel swaths and uniform heights of flight which result in less uniform recovery of DDT over the area. Nevertheless, it was concluded that if the basic swath section and intervals will provide satisfactory recovery of insecticide in calm air, it may be expected to provide satisfactory recovery in conditon of wind so long as uniform height of flight and parallel swaths may be maintained.

Under conditions of a mild (<8 mph.) cross wind and in the absence of obstruction, maximum recovery of insecticide and high fly mortality may be expected. Optimum conditions of treatment are shown in figure 6. Two open garbage dumps were treated at a flight altitude of 100 feet with a 6-mph. cross wind. Two types of wing sprays were used, one area being treated with 0.3 pound DDT per acre, the other with 0.5 pound DDT per acre. Three swaths were flown at 90-foot intervals and observations made at 20-foot intervals across the areas treated. On both dumps excellent fly mortality was observed with reduction of grill counts from about 600 to 50 or less in 4 hours. In both areas the fly kill obtained could have been largely accomplished without the aid of residual action.

Strong wind and obstructive cover may be expected to limit the recovery of insecticide due primarily to inability of maintaining uniform heights of flight, parallel swath, and by the mechanical barrier of foliage and buildings. A 10-square block section in an urban community [6] receiving routine treatment was studied for DDT recovery

[6] Wilmington, Delaware, during the P. H. S. Fly Control Project carried on in conjunction with Poliomyelitis Investigations, August and September 1947.

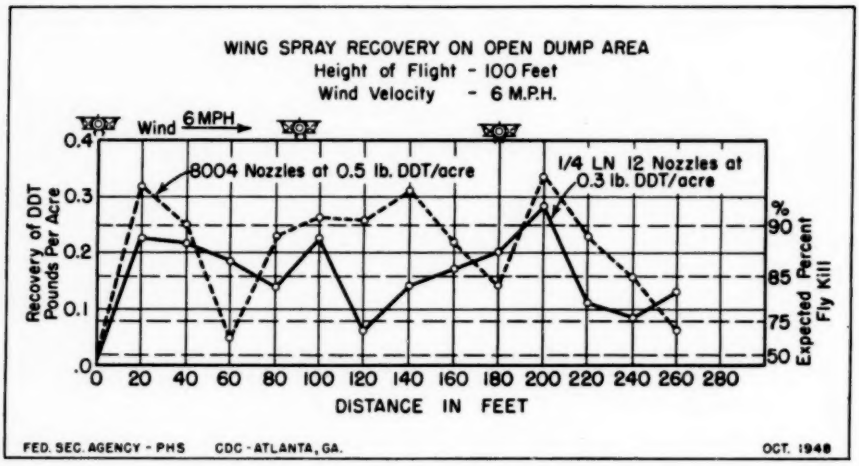
WING SPRAY RECOVERY ON OPEN DUMP AREA
Height of Flight - 100 Feet
Wind Velocity - 6 M.P.H.
Wind 6 MPH
8004 Nozzles at 0.5 lb. DDT/acre
1/4 LN 12 Nozzles at 0.3 lb. DDT/acre
Recovery of DDT Pounds Per Acre
Expected Percent Fly Kill
0.4
0.3
0.2
0.1
.0
90
85
75
50
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280
DISTANCE IN FEET
FED. SEC. AGENCY - PHS CDC - ATLANTA, GA. OCT. 1948

FIGURE 6. Maximum expected recovery in pounds DDT/Acre under optimum conditions of wind and cover.

under conditions of turbulent air with gusty winds up to 20 mph. in velocity. The pilot was unable accurately to maintain level flight or parallel swath due to rough air and cross drift. Observations revealed that the insecticide droplets reached the ground approximately 200 feet down-wind from point of release on most of the swaths and as far as 400 feet on several others. Slides for recovery data were placed under trees, in narrow passageways between buildings, back alleys and on the down-wind side of fences and buildings.

Recovery of DDT under these unfavorable conditions was studied and the results summarized in figure 7. The contours represent the approximate isomasses of insecticide recovered on the ground surface. All areas in the open such as streets, vacant lots, etc., were assumed to have a normal recovery of 0.25 pound per acre. Admittedly, the number of slides examined in this study was quite limited and certain assumptions were necessary in order to complete the contours. However, even with these limitations, it is believed that the contour method of presentation of the data most clearly portrays the distribution of the spray and the expected recovery. Surprisingly enough, no negative slides were obtained but recoveries in heavily vegetated areas were generally low so that about one-third of the area could not be considered satisfactorily controlled if allowance for residual kill was estimated at 25 percent.

Summary and Conclusions

1. Experimental studies on aircraft spray equipment provide basic data upon which practical and effective fly control may be achieved rapidly in urban communities.

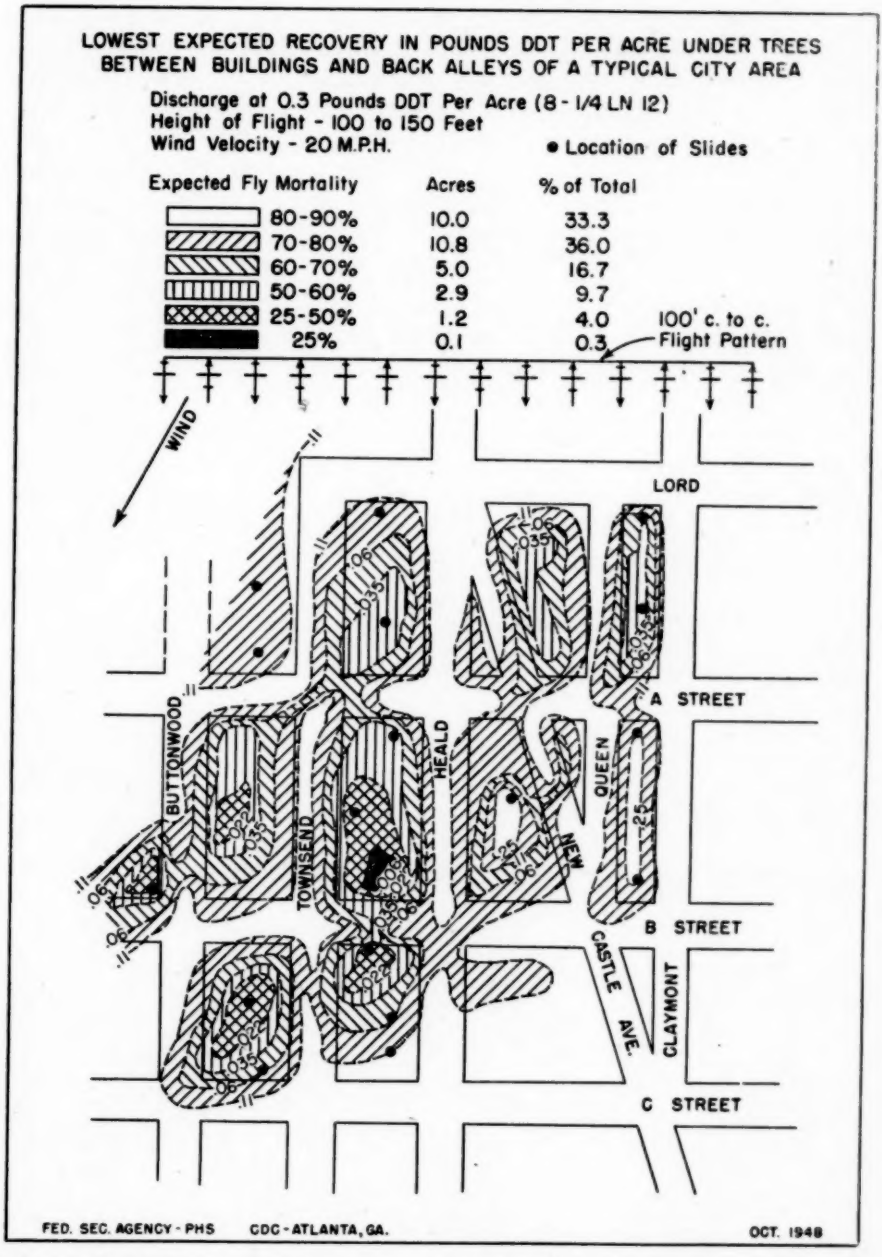

FIGURE 7. The lowest expected recovery of insecticide under typical urban cover when application is made during unfavorable weather conditions.

2. Fly control through the application of DDT solutions from aircraft is obtained jointly by mortality from direct contact with droplets and through residual toxicity on treated surfaces. The residual

toxicity is of short duration and in view of many variables can not be depended upon to provide more than 25 percent kill. Recoveries in excess of 0.1 pound of DDT per acre are required for satisfactory control with spray having median mass diameter (MMD) of from 160 to 200 microns.

3. Satisfactory fly control in urban situations without staining damage may be obtained with sprays having a MMD of 200 microns applied at heights of flight of from 100 to 150 feet. The desirable application rate is 0.5 pound DDT per acre (100-foot swath basis) using a solution of 30 percent Technical DDT in Velsicol AR–60.

4. Investigations indicate that 1, 2, 3, 4, 5, 6 hexachlorocyclohexane containing 10 percent available gamma isomer appears to be from 5 to 7 times more toxic than DDT in plane sprays for common flies.

5. Further study is indicated, especially in the use of more toxic insecticides and smaller but more abundant number of droplets.[7] A careful comparative evaluation of droplet contact and residual mortalities should be made in view of designing aircraft dispersal equipment to meet all requirements.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Dr. Griffith E. Quinby, Medical Officer in Charge and to the members of the Neurotropic Virus Disease-Insect Control Project of the Public Health Service who participated in planning and conducting of these studies. Much of the equipment development cited in this report was the work of J. H. Coffey, Executive Officer. The author is particularly indebted to Sidney B. Richter, Assistant Engineer, who enthusiastically collaborated in the development of test procedures and the collection of data. Gratitude is expressed to Dr. E. H. Hinman and members of the Biology Staff of the Tennessee Valley Authority for the hospitality and helpful advice given during the course of field studies conducted at Wilson Dam, Alabama. Finally, acknowledgment is made to Dr. Abel Wolman and staff of the Department of Sanitary Engineering, Johns Hopkins University, for advice and assistance in preparing this report.

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(*1*) Scudder, H. L.: A new technique for sampling the density of housefly populations. Pub. Health Rep. **62:** 681–686 (1947).

(*2*) Baker, W. C., Scudder, H. I., and Guy, E. L.: The control of houseflies by DDT sprays. Pub. Health Rep. **62:** 597–612 (1947).

(*3*) Quinby, G. E., Coffey, J. H., and McNeel, T. E.: The practicability of emergency fly control in a city. Unpublished reports of the Insect Control Unit, Neurotropic Virus Disease, P. H. S., Montgomery, Alabama.

(*4*) Keener, G. G. Jr., Cutkomp, L. K.: Physical and chemical characteristics of Velsicol fractions. Unpublished reports. Health and Safety Department, Tennessee Valley Authority, Wilson Dam, Alabama.

(*5*) Krusé, C. W., and Metcalf, R. L.: Airplane exhaust generators, Pub. Health Rep. **62:** 1171–1184 (1946).

[7] A preliminary step in this direction was made during the course of the fly control activities at Wilmington, Delaware, but the cessation of the project deferred its immediate development and appraisal. At the suggestion of Capt. George A. Thompson, Operations Entomologist, the eight 80-04 flat type spray nozzles on the wing and tail were directed downward across the air stream instead of the normal downstream position. With this cross-wind nozzle position the additional breakup of droplets was quite apparent, permitting discharge rates up to 4 gallons per minute.

PUBLIC HEALTH SERVICE PUBLICATIONS

January–June 1948

The purpose of this list is to provide a complete and continuing record of Public Health Service publications for reference use by librarians, scientific workers, and others interested in particular fields of public health work, and not to offer the publications for indiscriminate free distribution.

Single sample copies are available from the Public Inquiries Section, Division of Public Health Methods, Public Health Service, Washington 25, D. C.

Quantities may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., at prices shown, with a reduction of 25 percent on lots of 100 copies or more of a single publication.

The publications marked with an asterisk (*) may be obtained only by purchase.

PERIODICALS

*Public Health Reports (weekly), January–June, vol. 63, Nos. 1 to 26, pages 1 to 864. 10 cents a copy. Subscription price $4 a year.

Extracts from Public Health Reports (monthly), January–June, Tuberculosis Control Issues Nos. 23 to 28. 30 pages each. 10 cents a copy. Subscription price $1 a year.

*The Journal of Venereal Disease Information (monthly), January–June 1948, vol. 29, Nos. 1 to 6, pages 1 to 191. 10 cents a copy. Subscription price 75 cents a year.

*Journal of the National Cancer Institute (bimonthly), February–June, vol. 8, Nos. 4 to 6, pages 161 to 241. 40 cents a number. Subscription price $2 a year.

Public Health Engineering Abstracts (monthly), January–June, vol. XXVIII, Nos. 1 to 6, 32 pages each. No sales stock.

Industrial Hygiene Newsletter (monthly), January–June, vol. 8, Nos. 1 to 6, 16 pages each. 10 cents a number. Subscription price $1 a year.

National Negro Health News (quarterly), January–June, vol. 16, Nos. 1 and 2, 24 pages each. No sales stock.

REPRINTS FROM THE PUBLIC HEALTH REPORTS

2829. A preliminary report concerning DDT dusting and murine typhus fever in nine Southern States. By John S. Wiley. January 9, 1948. 4 pages. 5 cents.

2830. Some factors influencing the mouse potency test for rabies vaccine. By Karl Habel and John T. Wright. January 9, 1948. 12 pages. 5 cents.

2831. Public Health Service publications. A list of publications issued during the period January–June 1947. January 16, 1948. 5 pages. 5 cents.

2832. Some improvements in the performance test for rating dishwashing detergents. By Francis I. Norris and C. C. Ruchhoft. January 23, 1948. 13 pages. 5 cents.

2833. The isolation of enterococci from foods implicated in several outbreaks of food poisoning. By L. Buchbinder, A. G. Osler and G. I. Steffen. January 23, 1948. 9 pages. 5 cents.

2834. A comparison of the effectiveness of 5 and 10 percent DDT dusts for the control of rat fleas. By H. Page Nicholson and Thomas B. Gaines. January 30, 1948. 8 pages; 2 illustrations. 5 cents.

2835. The preparation of chlorine-demand-free water. By Stephen Megregian. January 30, 1948. 5 pages. 5 cents.

2836. Report of brucellosis outbreak at Federalsburg, Maryland. By James H. Steele and J. W. Hastings, Sr. January 30, 1948. 2 pages. 5 cents.

2837. Negro mortality. III. Course of mortality from specific causes, 1920–1944. By Mary Gover. February 13, 1948. 13 pages. 5 cents.

2838. Q fever studies in Southern California. I. Recovery of *Rickettsia burneti* from raw milk. By R. J. Huebner, W. L. Jellison, M. D. Beck, R. R. Parker, and C. C. Shepard. February 13, 1948. 9 pages. 5 cents.

2839. Two new *Salmonella* types: *S. hidalgo* and *S. mission*. By James Watt, Thelma M. DeCapito, P. R. Edwards and Alice B. Moran. February 13, 1948. 2 pages. 5 cents.

2840. An epidemic of acute watery diarrhea in Alabama. By John W. Smillie, Beatrice F. Howitt and George A. Denison. February 20, 1948. 12 pages. 5 cents.

2841. Federal-State-local relationships in the financing of local health services. By Malcolm H. Merrill. February 20, 1948. 8 pages. 5 cents.

2842. Epidemic tinea capitis: A public health problem. By Richard K. C. Lee. February 27, 1948. 8 pages. 5 cents.

2843. Relative productivity of newer coliform media. By Elsie Wattie. February 27, 1948. 6 pages. 5 cents.

2844. Morbidity reporting in local areas. I. Patterns of reporting. By Margaret D. West. March 12, 1948. 12 pages. 5 cents.

2845. Field tests with tick repellents. By James M. Brennan. March 12, 1948. 8 pages. 5 cents.

2846. Action of streptomycin in experimental infection with Q fever. By Robert J. Huebner, George A. Hottle, and Eleanor B. Robinson. March 19, 1948. 6 pages. 5 cents.

2847. Studies of the acute diarrheal diseases. XVIII. Epidemiology. By Albert V. Hardy and James Watt. March 19, 1948. 16 pages. 10 cents.

2848. Poliomyelitis in the United States, England and Wales in 1947. By C. C. Dauer; W. H. Bradley, and A. H. Gale. March 26, 1948. 8 pages. 5 cents.

2849. The importance of coverage in DDT residual house spraying for the control of *Anopheles quadrimaculatus* mosquitoes. By R. C. McCauley, R. W. Fay, and S. W. Simmons. March 26, 1948. 8 pages. 5 cents.

2850. New Surgeon General takes office and charts the road ahead in public health. April 9, 1948. 11 pages. No sales stock.

2851. Control of trichinosis. Report by the Committee on Public Health Relations, the New York Academy of Medicine. April 9, 1948. 12 pages. 5 cents.

2852. Program of the National Cancer Institute. April 16, 1948. 17 pages. No sales stock.
2853. Employment of soluble antigen in screening tests for typhus complement fixation. By T. O. Berge. April 23, 1948. 8 pages. 5 cents.
2854. Statistical studies of heart diseases. I. Heart diseases and allied causes of death in relation to age changes in the population. By I. M. Moriyama and Mary Gover. April 23, 1948. 9 pages. 5 cents.
2855. Operation of the Public Health Service malaria control program. By Frank Tetzlaff. April 30, 1948. 8 pages. 5 cents.
2856. Dental effects of community waters accidentally fluorinated for 19 years. By Henry Klein. April 30, 1948. 12 pages. 5 cents.
2857. Diphtheria epidemic in Utah in 1947. By Alton A. Jenkins. April 30, 1948. 6 pages. 5 cents.
2858. Appearance of "minimus" type diphtheria in Utah. By Ted. W. Galbraith, R. S. Fraser, and E. H. Bramhall. April 30, 1948. 4 pages. 5 cents.
2859. Illness among infants, with comparative mortality data. By Selwyn D. Collins. May 14, 1948. 26 pages. 10 cents.
2860. State-local grant-in-aid formulas. By A. L. Chapman and Clifford Greve. May 21, 1948. 5 pages. 5 cents.
2861. Changes in age selection of fatal poliomyelitis. By Alexander G. Gilliam. May 21, 1948. 8 pages. 5 cents.
2862. Studies of the acute diarrheal diseases. XIX. Immunization in shigellosis. By Albert V. Hardy, Thelma DeCapito, and Seymour P. Halbert. May 21, 1948. 4 pages. 5 cents.
2863. The distribution of endemic typhus in rats in Lavaca County, Tex. By J. V. Irons, J. N. Murphy, Jr., and David E. Davis. May 21, 1948. 4 pages. 5 cents.
2864. Leprosy in California—danger of infection. By G. W. McCoy. May 28, 1948. 8 pages. 5 cents.
2865. Public Health Service publications. A list of publications issued during the period July-December 1947. May 28, 1948. 6 pages. 5 cents.
2866. Nutrition studies. II. Methods of collecting dietary data. By Miriam G. Eads and Alla P. Meredith. June 11, 1948. 6 pages. 5 cents.
2867. Observations on rats and typhus fever in San Antonio, Tex. By David E. Davis. June 11, 1948. 8 pages. 5 cents.
2868. Studies of the acute diarrheal diseases. XX. Further observations of chemotherapy in shigellosis; the efficacy of streptomycin and sulfacarzole. By Albert V. Hardy and Seymour P. Halbert. June 11, 1948. 4 pages. 5 cents.
2869. Role of the dentist in oral cancer detection. By Ralph S. Lloyd. June 18, 1948. 8 pages. 5 cents.
2870. Objectives and program of the Arkansas cancer detection project. By Allen N. Koplin. June 18, 1948. 9 pages. 5 cents.
2871. The National mental health program. A progress report. By Robert H. Felix. June 25, 1948. 12 pages. 5 cents.
2872. Studies of acute diarrheal diseases. XXI. Salmonellosis in Florida. By Mildred M. Galton and Albert V. Hardy. June 25, 1948. 4 pages. 5 cents.

SUPPLEMENTS TO PUBLIC HEALTH REPORTS

204. Nation-wide inventory of sanitation needs. April 1948. 46 pages; 16 illustrations. 15 cents.

205. Research grants awarded by Public Health Service. January 1948. By C. J. Van Slyke. 41 pages. 15 cents.
206. The notifiable diseases. Reported incidence of certain communicable diseases, by States, 1946. April 1948. 14 pages. 5 cents.
207. Heat resistance studies with spores of *Bacillus anthracis* and related aerobic bacilli in hair and bristles. By Roy Schneiter and Robert W. Kolb. June 1948. 24 pages. 10 cents.
133. The public health nurse and you. Revised 1948. 13 pages; illustrated. 10 cents.
194. Directory of full-time local health officers. Revised 1948. 46 pages. 15 cents.

PUBLIC HEALTH BULLETIN

299. Health of workers exposed to sodium fluoride at open hearth furnaces. By J. Walter Hough, Dohrman H. Byers, Vernon J. Forney, Hugh P. Brinton, Robert G. Keenan, Robert P. Ralls, and Harold J. Paulus. 1948. 64 pages; 2 illustrations. 25 cents.

MENTAL HEALTH SERIES

1. For mental health. January 1948. 6-page folder, illustrated. 5 cents; $1.25 per 100.
4. The National Mental Health program. June 1948. 7 pages. 10 cents.

HEALTH INFORMATION SERIES

21. Home care of the sick. 1948. 6-page folder. 5 cents; $1.50 per 100.
29. The common cold. 1948. 4-page folder. 5 cents; $1.25 per 100.
31. Vitamins. 1948. 4-page folder. 5 cents; $1.25 per 100.
53. How to protect your hearing. 1948. 6-page folder. 5 cents; $1.50 per 100.
60. Whooping cough. 1948. 4-page folder. 5 cents; $1.25 per 100.
62. Neuralgia and neuritis. 1948. 4-page folder. 5 cents; $1.25 per 100.
63. Heart disease. 1948. 4-page folder. 5 cents; $1.25 per 100.
64. Care of the eyes. 1948. 4-page folder. 5 cents; $1.25 per 100.

ANNUAL REPORT

Annual Report of the United States Public Health Service for the fiscal year 1947. 205 pages. 40 cents.

UNNUMBERED PUBLICATIONS

Index to Public Health Reports, vol. 62, Part II, July–December 1947. 31 pages. 10 cents.

Contents and indexes to Journal of the National Cancer Institute, vol. 8, August 1947–June 1948. 1948. 6 pages. 5 cents.

Interstate quarantine regulations. 1948. 11 pages. 10 cents.

The physician in the U. S. Public Health Service. Revised 1948. 24 pages; illustrated. 15 cents.

Amendments to sections 22.70, 22.71, and 22.94 to Miscellaneous Publication No. 10. 1948. 3 pages. No sales stock.

Compilation of Public Health Service regulations. Supplements Nos. 11–14, December 16, 1947 through February 3, 1948. 4 pages. (For official use only).

Compilation of Public Health Service regulations. Supplement No. 15, February 25, 1948. 2 pages. (For official use only).

Compilation of Public Health Service regulations. Supplements Nos. 16–17, March 10 through April 6, 1948. 2 pages. (For official use only.)

Compilation of Public Health Service regulations. Supplements Nos. 18 and 19, April 29 and May 11, 1948, and corrections to Supplement No. 4. 2 pages. (For official use only.)

Compilation of Public Health Service regulations. Supplements Nos. 20–25, June 4 through July 8, 1948. 9 pages. (For official use only.)

National Negro Health Week program. Thirty-fourth observance, April 4–11, 1948. 4 pages; illustrated. Out of print.

National Negro Health Week leaflet. Thirty-fourth observance. 1948. 2 pages. Out of print.

Immunization information for persons proceeding abroad. 1948. 22 pages. 5 cents. $3.75 per 100.

International certificate of inoculation and vaccination. 1948. 5 cents; $1.25 per 100.

REPRINTS FROM THE JOURNAL OF THE NATIONAL CANCER INSTITUTE

67. Effects of X-ray irradiation on the development of ovarian tumors in intrasplenic grafts in castrated mice. By Min Hsin Li, W. U. Gardner, and Henry S. Kaplan. December 1947. 8 pages; 10 illustrations. No sales stock.
68. Evaluation of the carcinogenicity of a series of esters of carbamic acid. By C. D. Larsen. December 1947. 3 pages. No sales stock.
69. The use of perforated cellophane for the growth of cells in tissue culture. By Virginia J. Evans and Wilton R. Earle. December 1947. 17 pages; 15 illustrations. No sales stock.
70. Inhibition of androgen-induced comb growth in the chick with methylcholanthrene. By Roy Hertz and William Tullner. December 1947. 2 pages; 1 illustration. No sales stock.
71. Inhibition of estrogen-induced tissue growth with progesterone. By Roy Hertz, C. D. Larsen, and William Tullner. December 1947. 4 pages; 2 illustrations. No sales stock.
72. Thiamine deficiency and thiamine requirements in C3H mice. By Harold P. Morris and Celia S. Dubnik. December 1947. 11 pages; 10 illustrations. No sales stock.
73. Lesions of chronic thiamine deficiency in mice. By Thelma B. Dunn, Harold P. Morris, and Celia S. Dubnik. December 1947. 17 pages; 12 illustrations. No sales stock.
74. The effect of gonadectomy and adrenalectomy on the appearance and incidence of spontaneous lymphoid leukemia in mice. By L. W. Law. December 1947. 3 pages. No sales stock.
75. Effect of added phosphate on glutamine desamidation in tumors. By Jesse P. Greenstein and Florence M. Leuthardt. February 1948. 2 pages. No sales stock.
76. Effect of the injection of various substances upon the invivo electrical resistance of rats. By Herbert Kahler. February 1948. 6 pages; 7 illustrations. No sales stock.
77. Dehydropeptidase activity of normal and pathological human sera. By Alton Meister and Jesse P. Greenstein. February 1948. 3 pages; 1 illustration. No sales stock.
78. Heterologous and homologous growth of transplants during the course of, development of spontaneous mammary tumors in C3H mice. By Henry C. Browning. February 1948. 17 pages; 2 illustrations. No sales stock.

79. Comparative susceptibility of the lymphoid tissues of strain C57 black mice to the induction of lymphoid tumors by irradiation. By Henry S. Kaplan. February 1948. 7 pages; 3 illustrations. No sales stock.
80. Histopathologic study of the mode of inhibition of cellular proliferation by urethane: Effect of urethane on wound healing. By C. C. Lushbaugh, John W. Green, Jr., and John B. Storer. April–June 1948. 7 pages; 1 illustration. No sales stock.
81. Influence of age on the copper and zinc content in the epidermis of mice undergoing carcinogensis with methylcholanthrene and a note on the role of calcium. By E. V. Cowdry, C. Carruthers, and V. Suntzeff. April–June 1948. 5 pages; 2 illustrations. No sales stock.
82. Effects of podophyllin on mouse skin. I. Histologic sequence after a single dose. By Lester S. King. April–June 1948. 11 pages; 5 illustrations. No sales stock.
83. Mammary tumors in mice presumably free of the mammary-tumor agent. By Howard B. Andervont and Thelma B. Dunn. April–June 1948. 7 pages; 1 illustration. No sales stock.
84. Efforts to detect a mammary-tumor agent in strain C mice. By Howard B. Andervont and Thelma B. Dunn. April–June 1948. 6 pages. No sales stock.

REPRINTS FROM THE JOURNAL OF VENEREAL DISEASE INFORMATION

301. Statistical indices used in the evaluation of syphilis contact investigation. By Albert P. Iskrant and Harold A. Kahn. January 1948. 6 pages. 5 cents.
302. Status of contact investigation: An evaluation of data from State and local health areas. By Albert P. Iskrant and J. Wallace Rion. January 1948. 6 pages. 5 cents.
303. The 100-day experiment in contact investigation in Arkansas. By Edgar J. Easley, George E. Parkhurst, and Robert R. Swank. January 1948. 7 pages. 5 cents.
304. Family life, health, and social relations program in San Francisco. By Richard A. Koch and Noel Keys. February 1948. 6 pages. 5 cents.
305. Oklahoma City case-finding demonstration. By G. F. Mathews, A. B. Colyar, John A. Cowan, Charles A. Shumate, and John W. Morse. February 1948. 6 pages. 5 cents.
306. The telegram as a case-finding technic in venereal disease control. By Theodore J. Bauer, Amelia H. Baker, and M. E. Easterly. February 1948. 5 pages. 5 cents.
307. Treatment of chancroid with streptomycin. By Harold L. Hirsh and S. Ross Taggart. February 1948. 4 pages. 5 cents.
308. Hypospray administration of penicillin in the treatment of gonorrhea. By Robert A. Hingson, Edgar J. Easley, A. L. Gray, C. B. Tucker, Max R. Kiesselbach, George E. Parkhurst, Glenn S. Usher, and Harold H. Davidson. March 1948. 4 pages. 5 cents.
309. Evaluation of spinal fluid examinations. By Bernhard Dattner. March 1948. 4 pages. 5 cents.
310. Louisville-Jefferson county venereal disease case-finding demonstration. By William F. Lamb, Max R. Kiesselbach, and John W. Morse. March 1948. 5 pages. 5 cents.
311. The VDRL slide flocculation test for syphilis. II. A supplementary report. By Ad Harris, A. A. Rosenberg, and E. R. Del Vecchio. March 1948. 4 pages. 5 cents.

312. Syphilitic relapse vs. reinfection. By Ira Leo Schamberg and Howard P. Steiger. April 1948. 12 pages. 5 cents.
313. Rapid treatment of early syphilis: Progress report, December 1947. By J. R. Heller, Jr., Richard W. Bowman, and Eleanor V. Price. April 1948. 3 pages. 10 cents.
314. Delta plantation case-finding survey in Leflore County, Mississippi. By A. L. Gray, Mary Sim Ferguson, and Richard S. Hibbets. April 1948. 5 pages. 5 cents.
315. Venereal disease educational program in Nebraska. By Florence M. Walt. April 1948. 5 pages. 5 cents.
316. Mass blood testing in eight Georgia communities. By C. D. Bowdoin. May 1948. 6 pages. 5 cents.
317. The incidence of infection in contacts of early syphilis. By Arthur J. von Werssowetz. May 1948. 6 pages. 5 cents.
318. Local prophylaxis in experimental syphilis of the rabbit. By R. C. Arnold and J. F. Mahoney. May 1948. 4 pages. 5 cents.
319. Treatment of neurosyphilis at Hot Springs Medical Center, Arkansas. By George E. Parkhurst and Richard W. Bowman. June 1948. 8 pages. 5 cents.
320. Cardiolipin antigens in the Kolmer complement fixation test for syphilis. By John A. Kolmer and Elsa R. Lynch. June 1948. 7 pages. 10 cents.
321. Administrative advantages of rapid syphilotherapy on an out-patient basis. By H. D. Chope and James C. Malcolm. June 1948. 5 pages. 5 cents.
322. Cooperation of gonorrhea patients in locating contacts. By Amelia H. Baker, M. E. Easterly, and Henry Eisenberg. June 1948. 2 pages. 5 cents.

VENEREAL DISEASE FOLDER

4. Wedding plans. Venereal disease tests. Revised April 1948. 3 pages. 5 cents; $1.50 per 100.

UNNUMBERED PUBLICATION

Examples of acceptable penicillin schedules. Syphilis treatment schedules based on statement issued Dec. 1, 1947, by Syphilis Study Section, National Institute of Health, to Council on Pharmacy and Chemistry, American Medical Association. 1948. 1 page. No sales stock.

DEATHS DURING WEEK ENDED OCT. 30, 1948

[From the Weekly Mortality Index issued by the National Office of Vital Statistics]

	Week ended Oct. 30, 1948	Corresponding week, 1947
Data for 93 large cities of the United States:		
Total deaths	9,116	8,880
Median for 3 prior years	8,880	
Total deaths, first 44 weeks of year	403,826	403,352
Deaths under 1 year of age	632	689
Median for 3 prior years	689	
Deaths under 1 year of age, first 44 weeks of year	29,267	32,475
Data from industrial insurance companies:		
Policies in force	70,833,920	67,096,085
Number of death claims	12,484	13,084
Death claims per 1,000 policies in force, annual rate	9.2	10.2
Death claims per 1,000 policies, first 44 weeks of year, annual rate	9.3	9.3

INCIDENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED NOVEMBER 6, 1948

A net increase of 124 cases was reported in the incidence of poliomyelitis—from 830 last week to 954 currently, as compared with a 5-year (1943–47) median of 390 and 564 in 1946, the latter being the largest number for a corresponding week of the past 5 years. Of the 17 States reporting currently 10 or more cases, 8 showed a decline from 259 to 197, and 9 States, showing a combined increase of 213 cases, reported as follows (last week's figures in parentheses): New Jersey 42 (25), Ohio 28 (14), Illinois 23 (21), Minnesota 71 (63), Iowa 65 (44), South Dakota 111 (58), Virginia 21 (9), Georgia 11 (3), California 276 (198). The total for the year to date is 24,375, as compared with 22,941 for the same period in 1946 and a 5-year median of 12,342.

A total of 2,053 cases of influenza was reported for the week, as compared with 2,091 last week and a 5-year median of 1,438. A decline reported in Texas (from 1,205 to 856) was slightly more than offset by increases chiefly in Virginia (from 251 last week to 459), South Carolina (279 to 363), Indiana (0 to 41), Oklahoma (34 to 52), Arizona (27 to 69), and Georgia (4 to 22). The total since August 1 is 17,386 cases (5-year median 12,627), more than for any corresponding period in the past 6 years.

The increase in the incidence of measles (from 1,809 last week to 2,374) is chiefly accounted for in the reports of 6 States, as follows (last week's figures in parentheses): Massachusetts 359 (251), Pennsylvania 214 (24), Wisconsin 104 (60), Wyoming 104 (21), Colorado 146 (39), and California 126 (38).

One case of smallpox was reported for the week, in Tennessee, and 1 case of Rocky Mountain spotted fever, in Oklahoma. Of 13 cases of tularemia reported, no State reported more than 2 cases.

Deaths recorded during the week in 93 large cities in the United States totaled 8,990, as compared with 9,116 last week 8,638 and 8,663, respectively, in 1947 and 1946, and a 3-year (1945–47 median of 8,663). The total for the year to date is 412,816, as compared with 411,990 for the corresponding period last year. Infant deaths totaled 667, last week 632, 3-year median 688. The cumulative figure is 29,934, same period last year 33,163.

Telegraphic case reports from State health officers for week ended November 6, 1948

(Leaders indicate that no cases were reported)

Division and State	Diphtheria	Encephalitis, infectious	Influenza	Measles	Meningitis, meningococcal	Pneumonia	Poliomyelitis	Rocky Mt. spotted fever	Scarlet fever	Smallpox	Tularemia	Typhoid and paratyphoid fever [4]	Whooping cough	Rabies in animals
NEW ENGLAND														
Maine	2			149		2	1		18				5	
New Hampshire			1						1					
Vermont				34		3			10				13	
Massachusetts	7	1		359		9			69				47	
Rhode Island				3		6			5				2	
Connecticut	1			32		40	1		25				9	
MIDDLE ATLANTIC														
New York	7		[5] 4	110	3	150	43		[6] 94			2	77	11
New Jersey				44	3		42		48			2	73	
Pennsylvania	1		([5])	214	2		24		111			4	122	1
EAST NORTH CENTRAL														
Ohio	6		3	42	3	48	28		163			1	40	12
Indiana	6	4	41	18	1	11	9		32		1	1	25	16
Illinois	1	1		13	3	82	23		83			2	44	2
Michigan [3]			3	98	1	28	29		81		1	2	17	1
Wisconsin			3	104	2	5	30		32				15	
WEST NORTH CENTRAL														
Minnesota	1			1	1	1	71		18		1	1	1	
Iowa	1			5		3	65		17			1	16	
Missouri	5		1	37	1	16	8		20			2	3	
North Dakota	3	2		21			2		12				24	
South Dakota	2			1			111		4					
Nebraska	2		19	7	1		11		9				1	
Kansas	5		3	4		12	5		22			1	4	
SOUTH ATLANTIC														
Delaware						2	1							
Maryland [3]	5		1	67	1	27	6		[6] 13			2	7	
District of Columbia	1			6		18	3		8				4	
Virginia	12		459	32	2	41	21		40		1		6	2
West Virginia	7		11	22	1	4	6		14				10	
North Carolina	20	1		21	1		[1] 17		35		2	1	13	
South Carolina	38		363	7		69	3		9			2	9	4
Georgia	25		22	1	2	15	11		55			1		8
Florida	10			3		13	5		15			2	7	1

Telegraphic case reports from State health officers for week ended November 6, 1948—Continued

(Leaders indicate that no cases were reported)

Division and State	Diphtheria	Encephalitis, infectious	Influenza	Measles	Meningitis, meningococcal	Pneumonia	Poliomyelitis	Rocky Mt. spotted fever	Scarlet fever	Smallpox	Tularemia	Typhoid and paratyphoid fever [d]	Whooping cough	Rabies in animals
EAST SOUTH CENTRAL														
Kentucky	16		1	2	1	12	8		37			1	19	
Tennessee	29		24	30	3	46	9		90	1		6	12	
Alabama	40		6	24	2	30			24		1	1	7	
Mississippi [a]	10		3	23		11	1		11		2	3		
WEST SOUTH CENTRAL														
Arkansas	5		48	[1] 4	[1] 1	15			12			4	5	3
Louisiana	10		2	4	2	15	4		15		1	2	3	1
Oklahoma	13		52	5	1	24	5	1	24			2	2	3
Texas	12		856	227		82	25		25			2	42	34
MOUNTAIN														
Montana				7		24	1		5		1	1	5	
Idaho			3	16	1	9	3		[c] 18				8	
Wyoming	2		1	104		1	4		3					
Colorado	1		40	146	1	25	6		14		1	5	15	
New Mexico			1	7		2			4			6	1	
Arizona	5		69	10	3	26	7		2			3	3	
Utah [a]	1		3	91		4	8		3		1		17	
Nevada				1										
PACIFIC														
Washington	1			22	2	5	18		33				4	
Oregon	2	1	5	80		18	3		23				10	
California	7	1	5	126	3	15	276		69			13	42	2
Total	322	11	2,053	2,384	48	969	954	1	1,475	1	13	76	789	
Median, 1943–47	403	12	1,438	1,261	88		390	3	2,474	4	7	83	2,055	
Year to date, 44 weeks	7,982	490	156,201	[1] 562,393	[1] 2,765		[1] 24,375	508	64,185	54	820	3,142	66,527	
Median, 1943–47	11,115 (27th)	564	202,824 (30th)	554,188 (35th)	7,103 (37th)		12,342 (11th)	456	116,334 (32nd)	310 (35th)	632	4,365 (11th)	106,880 (39th)	
Seasonal low week ends	July 10		July 31	Sept. 4	Sept. 18		Mar. 20		Aug. 14	Sept. 4		Mar. 20	Oct. 2	
Since seasonal low week	3,372		17,386	[1] 10,979	[1] 329		[1] 24,025		8,569	4		2,669	2,604	
Median, 1943–47	4,851		12,627	7,018	608		11,945		16,048	31		3,741	9,344	

[a] Period ended earlier than Saturday.
[b] New York City and Philadelphia only, respectively.
[c] Including cases reported as streptococcal infection and septic sore throat.
[d] Including paratyphoid fever, reported separately, as follows: North Carolina 1; Oklahoma 1; Arizona 1; California 9. Salmonella infections, not included, were reported separately, as follows: Massachusetts 2.

[1] Corrections: Poliomyelitis, North Carolina, week ended Sept. 18, 75 cases (instead of 76); week ended Sept. 25, 85 cases (instead of 86); week ended Oct. 2, 74 cases (instead of 75); Meningitis, meningococcal, Arkansas, week ended Oct. 23, 0 cases (instead of 2) Measles, Arkansas, week ended Oct. 23, 3 cases (instead of 2).
Alaska: Scarlet fever 4.
Territory of Hawaii: Measles 122.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Week ended October 16, 1948.—During the week ended October 16, 1948, cases of certain communicable diseases were reported by the Dominion Bureau of Statistics of Canada as follows:

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Chickenpox		11	1	39	181	34	15	95	137	513
Diphtheria			2	6	4	2			2	16
Dysentery, bacillary				3						3
German measles					9		1	3	10	23
Influenza		31			9	2				42
Measles		162	2	111	39	19	11	15	29	388
Meningitis, meningococcal		1								1
Mumps		19		32	78	30	9	18	23	209
Poliomyelitis			2	1	10	4	2	16	7	42
Scarlet fever		3	3	5	33	6	2	5	5	62
Tuberculosis (all forms)		6	5	75	23	30	19	6	41	205
Typhoid and paratyphoid fever			1	9						10
Undulant fever		1		2	3	1			1	8
Venereal diseases:										
Gonorrhea	1	5	10	108	72	19	18	41	46	320
Syphilis		9	7	54	40	5	3	6	12	136
Whooping cough				50	16	4	12	5		87

Measles, Arkansas, week ended Oct. 23, 6 cases (instead of 2); Arkansas, week ended Oct. 2, 0 cases (instead of 2)
Alaska: Scarlet fever 4.
Territory of Hawaii: Measles 122.

WORLD DISTRIBUTION OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER

From consular reports international health organizations, medical officers of the Public Health Service, and other sources. The reports contained in the following tables must not be considered as complete or final as regards either the list of countries included or the figures for the particular countries for which reports are given.

NOTE.—Since many of the figures in the following tables are from weekly reports the accumulated totals are for approximate dates.

CHOLERA

(Cases)

Place	January–August 1948	September 1948	October 1948—week ended—				
			2	9	16	23	30
AFRICA							
Egypt	1						
Cairo	1						
ASIA							
Burma [1]	44				1		
Akyab [1]	5						
Bassein	1						
Moulmein					1		
Rangoon	2						
China:							
Hupeh Province	3						
Wuchang	3						
Kiangsi Province	[2] 9						
Kiangsu Province	2						
Shanghai	1						

See footnotes at end of table.

[1] Including paratyphoid fever, reported separately, as follows: North Carolina 1; Oklahoma 1; Arizona 1; California 9. Salmonella infections, not included, were reported separately, as follows: Massachusetts 2.

CHOLERA—Continued

Place	January–August 1948	September 1948	October 1948—week ended— 2	9	16	23	30
ASIA—continued							
India	132,024	16,835	[3] 1,489	[4] 338	[4] 178	[4] 165	
Ahmadabad	67	9	1				
Alleppey	1						
Allahabad [1]			1	2			
Bombay [1]	35	5	1		2	1	
Calcutta [1]	7,065	181	42	46	52	70	
Cawnpore	131	25	1				
Cocanada	10	5					
Colachel	12						
Cuddalore	12	1	7	9			
Jodhpur [1]	3	53					
Kilakarai	21						
Lucknow	43	1		4			
Madras	218	164	133	277	124	94	
Nagpur	61	10					
Negapatam	16						
New Delhi	26						
Raj Samand	6						
Tuticorin	16						
Vizagapatam	1						
India (French);							
Chandernagor	21						
Karikal	300						
Pondicherry	369	32					
India (Portuguese)	29						
Indochina (French);							
Annam		[5] 22	[5] 19				
Cambodia	1,344	3					
Cochinchina	588		1	1			
Bien Hoa	1						
Chaudoc	2						
Cholon	29						
Giadinh	23						
Longxuyen	7						
Mytho	56						
Rachgia	132		1				
Saigon	137						
Laos	[6] 32						
Tonkin	20						
Pakistan	25,011	[7] 445					
Chittagong	34					1	
Karachi	4						
Lahore	224	72	23	31		23	
Siam	43						
Syria	3						

[1] Includes imported cases. [2] Suspected. [3] Preliminary figures. [4] In ports only.
[5] Includes suspected cases. [6] Includes 12 deaths reported as cases in February 1948.
[7] For week ended Sept. 4, 1948.

PLAGUE

(Cases)

AFRICA							
Belgian Congo	16	1					
Costermansville Province	11						
Stanleyville Province	5	1					
British East Africa:							
Kenya	32						
Tanganyika	278	1					
Madagascar	354	13		[1] 3			
Tamatave	1						
Tananarive	32	2	1				
Rhodesia, Northern	26						
Union of South Africa	[2] 37	[3] 1			[3] 1		
ASIA							
Burma [4]	645	67		5	3	6	
Mandalay	17			1			
Rangoon	19						
China:							
Chekiang Province	37						
Wenchow	12						
Fukien Province	340	1					
Foochow	4						
Kiangsi Province	19						
Kwangtung Province	116						
Yunnan Province	95				[5] 1	[5] 22	[5] 13

See footnotes at end of table.

PLAGUE—Continued

Place	January–August 1948	September 1948	October 1948—week ended— 2	9	16	23	30
ASIA—continued							
India	20,257	467					
Indochina (French):							
Annam	142	14	9	10	4	3	
Cambodia	3						
Cochinchina	43	2					
Laos	2						
Mountain Area South-Indochina	12						
Java	863	[6] 63					
Pakistan	11						
Siam	114	3					
EUROPE							
Portugal: Azores	13	1					
SOUTH AMERICA							
Argentina	12						
Buenos Aires Province	9						
Brazil	[7] 60						
Alagoas State	22						
Bahia State	27						
Ceara State	5						
Pernambuco State	6						
Ecuador	27	7					
Chimborazo Province	1						
Loja Province	26	7					
Peru	22		4				
Cajamarca Department	11						
Libertad Department	1						
Lima Department	10		4				
Venezuela:							
Aragua State	7						
OCEANIA							
Hawaii Territory: Plague-infected rats [8]	5						

[1] Oct. 1–10, 1948.
[2] Includes 4 cases of pneumonic plague.
[3] In Cape Province.
[4] Includes imported cases.
[5] Outbreak in Hsiakwan (Hsia-kuan).
[6] Includes 1 case of pneumonic plague in Surabaya.
[7] Jan. 1–May 31, 1948.
[8] Plague infection was also reported in Hawaii Territory, under date of Feb. 27, 1948, in a mass inoculation of tissue from 19 rats.

SMALLPOX

(Cases—P=present)

AFRICA							
Algeria	274	43					
Angola [1]	185						
Basutoland	3						
Belgian Congo [1]	1,646	366					
British East Africa:							
Kenya	106	5	2				
Nyasaland	3,393	344	69	10			
Tanganyika	847	125	9	17			
Uganda	204	1	1				
Cameroon (French)	3						
Dahomey	337	83	18	6			
Egypt [2]	449	[3] 2	[3] 1				
Eritrea	9						
Ethiopia	20						
French Equatorial Africa	16						
French Guinea	129	3					
French West Africa: Haute-Volta	437	1					
Gambia	27						
Gold Coast	1,132	188	9				
Ivory Coast	626	68	7				
Libya	256						
Mauritania	1						
Mauritius	[4] 1						
Morocco (French)	35			[5] 1			
Mozambique	219	43					
Nigeria	3,853						

See footnotes at end of table.

SMALLPOX—Continued

Place	January–August 1948	September 1948	October 1948—week ended— 2	9	16	23	30
AFRICA—continued							
Niger Territory	361	6					
Rhodesia:							
Northern	585	42		11	17	3	
Southern	1,513						
Senegal	9						
Sierra Leone	168	5					
Sudan (Anglo-Egyptian) [1]	1,386	14	6	23	2		
Sudan (French)	17						
Swaziland	5						
Togo (British)	9						
Togo (French)	92	2		[4] 4			
Tunisia	516	8					
Union of South Africa	52	54	P		P		
ASIA							
Arabia	8						
British North Borneo	1						
Burma [2]	2,785	25	3	7	[6] 2	[6] 3	
Ceylon [2]	19						
China [2]	3,705						
India	57,143	858	[7] 132	[7] 107			
India (French)	6						
India (Portuguese)	150	15					
Indochina (French)	3,782	76	21	6			
Iran	544	15					
Iraq [2]	822	98	18	18	12	9	
Japan	26	1					
Java	1						
Lebanon [2]	59	2	1				
Macao [8]		11					
Malay States (Federated)	419	43	9	21			
Manchuria	78						
Pakistan [2]	11,756	[7] 20					
Palestine	8						
Siam	497	24	3	10			
Straits Settlements	[9] 11	2					
Sumatra [2]	1,696	[10] 2					
Syria	102	39					
Transjordan	13	1					
EUROPE							
France	3						
Germany	3						
Greece	8						
Italy [2]	2	1					
Portugal	74					[11] 1	
Spain	19						
Canary Islands	9						
Turkey				6		1	
NORTH AMERICA							
British Honduras	2						
Guatemala	2						
Mexico	914						
SOUTH AMERICA							
Argentina	13	7	3				
Bolivia	31						
Brazil	244						
Chile	8						
Colombia	5,376	323					
Ecuador [1]	2,768	102					
Paraguay [1]	96	5					
Peru [1]	1,120						
Trinidad	[12] 12						
Venezuela [1]	4,063	50			26	24	

[1] Includes Alastrim.
[2] Includes imported cases.
[3] In Alexandria.
[4] In Port Louis—imported.
[5] Oct. 1–10, 1948.
[6] In Rangoon.
[7] Preliminary figures.
[8] Seaport in Portuguese colony on Island of Macao, China.
[9] Corrected figure.
[10] In Padang.
[11] In Oporto.
[12] Alastrim.

TYPHUS FEVER*

(Cases)

(P=Present)

Place	January–August 1948	September 1948	October 1948—week ended— 2	9	16	23	30
AFRICA							
Algeria	162	9					
Basutoland	8						
Belgian Congo	179	18					
British East Africa:							
Kenya [1]	69						
Zanzibar	1						
Egypt	294	9	20	[2] 2	[2] 1	[2] 1	
Eritrea	53		1				
Ethiopia	75						
French Equatorial Africa	1						
Gold Coast [1]	7						
Libya	473	10	5	2			
Morocco (French)	73	3			[3] 1		
Morocco (International Zone)	5						
Morocco (Spanish) [1]	8						
Mozambique [1]	3						
Nigeria [1]	7						
Rhodesia (Southern)	[4] 1						
Senegal	[4] 4						
Sierra Leone	[4] 9						
Somalia	2						
Tunisia [1]	607	4					
Union of South Africa [1]	332	20	P	1			
ASIA							
Burma	5						
China [1]	161	6			[3] 1		
India (Portuguese)	7						
Indochina (French) [1]	53	10	3	2	1		
Iran [1]	127	4					
Iraq [1]	193	7	1	1	1		
Japan	453	3					
Java	3						
Manchuria	39						
Pakistan	22						
Palestine [1]	12						
Philippine Islands [1] [5]	5						
Straits Settlements [1]	20						
Syria [1]	58						
Transjordan	[6] 60						
Turkey (see Turkey in Europe).							
EUROPE							
Albania	15						
Bulgaria	736	6					
Czechoslovakia	7	1					
France	5						
Germany	21						
Great Britain:							
Cyprus [4]	1						
England and Wales	[4] [7] 2						
London	[4] [7] 1						
Ireland (Northern)	[4] 2						
Malta [4]	14	2		1			
Greece [4] [5]	122	40	13	16	31		
Hungary	51	4			1		
Italy [1]	306	113					
Sicily	5						
Netherlands	[4] 1						
Poland	261	15					
Portugal—Madeira Islands:							
Funchal	1						
Rumania [1]	21,672	59	9	10			
Spain	19	1					
Turkey	283	17	10	2	2	4	
Yugoslavia	565	14	6				
NORTH AMERICA							
Costa Rica [4]	10	2					
Cuba [4]	20	2					
Guatemala	106						
Jamaica [4]	17	1					
Mexico [1]	1,036	12					
Panama Canal Zone [1]	5						
Panama Republic	1						
Puerto Rico [4]	30	6		1			

See footnotes at end of table.

TYPHUS FEVER—Continued

Place	January–August 1948	September 1948	October 1948—week ended— 2	9	16	23	30
SOUTH AMERICA							
Argentina	20						
Bolivia	[8] 105						
Brazil	115	1		2			
Chile [1]	263	6	1				
Colombia [1]	2,178	309	4	2	11		
Curaçao [4]	13	2					
Ecuador [1]	373	1					
Peru	399						
Venezuela [1]	136	6	[9] 1	[10] 1			
OCEANIA							
Australia [4]	134	7		4			
Hawaii Territory [4]	12						
Honolulu	2						
New Caledonia	1						

*Reports from some areas are probably murine type, while others include both murine and louse-borne types.

[1] Includes murine type.
[2] In ports only.
[3] Oct. 1–10, 1948.
[4] Murine type.
[5] Includes suspected cases.
[6] Corrected figure.
[7] Imported.
[8] Includes 9 deaths reported as cases in Cochabamba Department in March 1948.
[9] In Porlamar.
[10] In Carupano.

YELLOW FEVER

(C—cases; D—deaths)

AFRICA								
French West Africa-Sudan:								
Sebekoro	D							1
Gold Coast:								
Kumasi	D	1						
Accra	D	2						
Ivory Coast:								
Gagnao	D	1						
SOUTH AMERICA								
Argentina:								
Cerro Azul, Misiones Territory	D	1						
Bolivia.[3]								
Brazil:								
Ilheus City, Itajuipe, Bahia State	D	1						
Sao Luiz Gonzaga Rio Grande do Sul State	D	[1] 1						
British Guiana	D		[2] 1					
Colombia;								
Antioquia Department:								
Maceo	D	4						
Yolomba	D	1						
Boyaca Department:								
Campohermoso	D	1						
Caldas Department:								
La Dorado	D	1						
Samana	D	1						
La Victoria	D	1						
Cundinamarca Department:								
Medina	D	7						
Intendencia of Meta;								
Cumaral	D	1						
Restrepo	D	1						
San Martin	D	1						
Peru.[4]								
Venezuela:								
Boatanamo, Tumeremo County, Bolivar State	D				1			

[1] Suspected.
[2] Delayed report: During the months of April and May *1947*, 5 confirmed cases of yellow fever were reported in Bolivia, distributed as follows: Santa Cruz Department—Nuflo de Chavez 1, Concepcion 1, Cercado 1; La Paz Department—Province of Sud Yungas Chulumani 1; Province of Nor Yungas, Coroico 1. (See PUBLIC HEALTH REPORTS for July 30, 1948 p. 1,024).
[3] In forested area, 60 miles up Berbice River from Kwakwani,
[4] Delayed report; On July 23, 1948, 1 death from yellow fever was reported to have occurred in Tingo Maria Huanuco Province, Huanuco Department, Peru, in the month of *November 1947*.